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EXPERIENCES IN THE DEVELOPMENT OF MULTI-PURPOSE AGRICULTURAL MACHINERY PLANTS *

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I. Introduction

1. One of the major functions of UNIDO is to provide assistance to developing countries in the promotion and acceleration of their industrialization, in particular in the development, expansion, modernization, and operation of their industries including agro-industries and basic industries.

With the purpose of expediating the solution of the food problems, tc assist developing countries to establish agricultural industries, to provide sufficient agricultural machines and implements of good quality in fairly rich assortment, and to take this as starting point for developing national or local industries is a strategy of great significance. In this respect, UNIDO has been proceeding with numerous fruitful activities including consultation conferences, a series of meetings on international cooperation and exchange of experience in the field of agricultural machinery industries; seminars on R & D of agricultural machinery; training courses for personnel to meet specific needs; technical-economical cooperation, etc. All these helpful activities have drawn great attention of many countries and yielded positive results.

2. In order to promote agricultural machinery industries and allied industries more effectively in the light of specific conditions of developing countries, a proposal concerning multi-purpose production and service was put forward on the Second Consultation on the Agricultural Machinery Industry held in Vienna, October 1983, that the agricultural machinery plant should diversify its production and service by integrating manufacture of agricultural machinery products with allied capital goods. After extensive discussion, the participants recognized the establishment of multi-purpose agricultural machinery plant to be a worthwile approach for developing countries. It will promisingly meet the diversified needs for agricultural production and rural construction, as well as allied sectors. In this

connection, the Second Consultation confirmed the proposal concerning the development of multi-purpose agricultural machinery plant and recorded it in the Consultation Report.

The Fourth General Conference of UNIDO held in Vienna, 2--18 August 1984, put forward a proposal concerning industrial policies and means which is important for developing countries to accelerate their rural development and to achieve self-sufficient food supply. To carry out " multi-purpose " approach will certainly contribute to the fulfilment of this proposal.

Considering the necessary follow-up of the proposal, UNIDO resolved, after consultation with interested parties, that a panel meeting will be held in China. The experts will investigate the experiences in the development of multi-purpose agricultural machinery plant in China, exchange of experiences, and go further into the approaches and steps for the realization of the proposal.

3. For years, China has accumulated to a certain extent experiences in the development of agricultural machinery industry. Further, along with the development of agricultural production and rural construction, the agricultural machinery industry is changing and evolving. However, practices over a long period of time shows that the " multi-purpose " is a correct orientation, and an inevitable result as well.

China now has nearly 2,000 of small- and medium-scale agricultural machinery plants at county level, varied in scale and characteristics in line with local conditions, spreaded all over the country. The layout of some plants appear evidently less rational from a modern viewpoint due to some restrictive factors left over by specific historical conditions. Consequently it is difficult to take one or two plants as ideal representative models. After investigation and study of a number of plants, the authors of the documents present two layouts, one for each, of small- and medium-scale plant. The layouts are worked out on the basis of summing up the characteristics and experiences of numbers of plants

with the aim of submitting a kind of reasonable layout to be discussed on the meeting.

The first document systematically introduces the common experiences of importance in the development, construction, management, and service of the multi-purpose agricultural machinery plants.

The second document elaborates the two layouts in detail.

4. It is necessary to mention a second time that these documents are prepared on the basis of China's practical experiences which can be only for reference for other countries, because the societal, economic, and agricultural conditions are different from country to country and place to place. As you experts here know very well, the detail design of a plant must be, and only can be worked out in line with the specific requirements and conditions of the locality.

II. The history of the agricultural machinery plant has witnessed the necessity and the inevitability of " multi-purpose "

5. China is a developing country with a population of one billion an cultivated land only around 100 million hectares. The development of agricultural machinery industry has been extremely a complex task owing to the limited per capita farmland, historically weak foundation of industry, and great diversities in nature and economic conditions from place to place over the country.

Before Liberation, China has practically no agricultural machinery industry at all. Blacksmiths in villages and towns provided peasants with simple handmade tools such as hoes, sickles, etc.

Only after the founding of New China, has the government started to encourage the production of improved human-operated

and animal-drawn implements, and then proceeded to develop and produce motorized agricultural machinery. Up to now, China has approximately 2,000 agricultural machinery plants at county level for both manufacture and repair service in addition to a certain number of large-scale or specialized tractor plants and agricultural machinery plants. Most of these small- and medium-scale plants have grown up on the basis of united individul or collective blacksmiths' shops and other workshops. Despite the simple and crude equipment and the primary technology they had at their initial stage, these plants have been growing in scale and now are capable of producing agricultural machines and implements of thousands of categories in various sizes. Besides, these plants also provide services for more than 3 million existing agricultural tractors, big or small. In a word, they have significantly contributed towards the agricultural production and become the sound base of China's agricultural machinery industry.

6. Agricultural machinery plants at the grass-roots have been forging still ahead in the past few years

The newly applied agricultural policies, especially the job responsibility systems, have highly brought the initiative of peasants into play. As a result, agricultural production are increasingly developing both in depth and in scope. The peasants not only do planting, but also do foresting, fishing, animal raising, agricultural and side-line product processing, transportation, and, in fact, all kinds of undertakings which are of vital importance to the rural construction and development. Seeing that these plants might be almost the only machinery plants in the rural areas of China, the government calls for " producing whatever the peasants need ", not only varieties of agricultural machinery and implements, but also allied capital goods and even household appliance. Such being the case, the implication of the word " multi-purpose " has been further enriched.

7. "Multi-purpose" is an effective measure to solve the problem of imbalance of production caused by the seasonal fluctuations of agricultural machinery market. The planning personnel of the plants used to be troubled with this kind of fluctuation or imbalance. Now things are different, however, the plants have ample work load in the slack season of production of agricultural machinery. They are busy to produce allied capital goods and household appliance, especially the products which can be produced with equipment and labor having surplus capacity. To make full use of the existing production capacity may bring about to the plants notable economic results. China's agricultural machinery plants make the most of their " multi-purpose " function while serving the agriculture first. A number of plants, sometimes, have their output value and profit of products other than agricultural machines make up a larger proportion of the total, thus promoting the production of agricultural machinery instead of weakening it.

8. "Multi-purpose" is essential to the up-grading and expension of agricultural machinery plant itself. Almost all of the agricultural machinery plants have developed from small to large. Only when the plants have a capacity to produce manifold agricultural machines as well as allied capital goods, can they satisfy the diversified demands of the society and, in the same time, progressively equip themselves with additional equipment and technology at higher level. The " multi-purpose " approach is essential to a plant to maintain self-reliance and grow from strength to strength, and to serve as a " nucleus " for building up indigenous industry.

9. The management ability and service quality have been improved through the practice of operation of " multi-purpose " plant. In the past, all the activities of production of China's agricultural machinery plants were channeled into with the plans of responsible departments at corresponding levels. The plants simply carried out production work without concerning to diversify product categories, or to market their products. The products of the plants were somewhat monotonous and

production management was uncomplicated. However, the policies of today stipulate that rely mainly upon the planned economy while making market economy subsidiary. The peasants, the customers, will act on their own initiative, and buy whatever machines and implements they think appropriate with their own money. Such a pressing situation requires much changes and improvements to be made in the field of market investigation, new product development, planning, management, after-sale service, etc. The improvements in management and administration enable numbers of plants to manifest the superiority of the " multi-purpose " approach which leads the output value and profit to increase year by year.

10. The function and scale of agricultural machinery plants vary from place to place. It is impossible to have an unique model for them all. Take Guangdong Province, the site of this meeting, for example, in 1982 there are 99 agricultural machinery plants at county level. An average of them has about 226 staff and workers, 4,800 square metres of floor areas; 52 machine tools and forging equipment; fixed assets(net) amount to 870,000 yuan; yearly consumed steel 260 tons and pig iron 120 tons. The average productivity in 1982 was 3,854 yuan/person.

Analyses of selected plants to be visited during this meeting are shown in table 1 and 2.

III. Points of importance to the establishment and operation of " multi-purpose " agricultural machinery plant

11. The effective government policies and supports are the key prerequisits for establishing multi-purpose agricultural machinery plants. Chinese government has attached great importance to agriculture and agricultural mechanization since the founding of new China and has given a number of instructions or watchwords such as " agriculture is the fundation of national economy ", " the fundamental way out

for agriculture lies in mechanization ", and so on. The government also has formulated a whole set of policies for promoting agricultural machinery. For example, for implementing the government policy issued in the 50's that each and every county throughout the country should have agricultural machinery plant, numerous county-level tractor and agricultural machinery repair plants/stations were set up, of which grew out numbers of multi-purpose agricultural machinery plants. At the initial stage of the construction of agricultural machinery plants, the government provided the requisite funds and brought the construction of plants into line with the state capital construction plan. Moreover, the government provided the plants in all parts of the country with necessary equipment in spite of the shortage of machine tools at that time. The leading products of agricultural plants are generally taken as a part of the national economy plan of the locality, thus ensuring supply of funds and raw materials. The government, still more, has applied appropriate price policies and fuel supply policies as well as other supports to help the plants to tide over transient difficulties and move progressively towards self-reliance. For years, the plants have trained large number of skilled workers and capable technical personnel, of them quite a few have been appointed heads of plants. All the government supports have ensured the development of agricultural machinery plants.

12. <u>The plants should be equiped, both physically and mentally, with greater flexibility and ability to meet the changing demands</u>. With the development of rural production, peasants have been diversifying their demand for machinery and equipment not only for agriculture, but also for forestry, animal-husbandry, fishery, and side-line product processing.

The progressing agricultural production technology often require new type of agricultural machines. For example, the newly developed plastic film mulching technology has been warmly and widely welcome by peasants. It is because that the yield of cotton, some vegetables and other crops can

increase by 10-30% with this method. The peasants urgently demand that the plants provide film mulching equipment in large quantities. As a result of the flexibility and quick actions taken by the plants, thousands of such equipment, of different sizes and constructions, have been turned out, thus enabling the spreading of the new technique with an unpredicated fast speed all over China. Therefore, it is necessary for a plant to have its facilities and personnel's technical competence sufficiently flexible to meet changeable environment. Also the plants should know how to manage the seasonally diversified and comparatively small-batch production. In short, the head of a plant should always keep in mind and be flexible to the changeable market demand.

13. Solid backing of basic industries is indispensable for developing multi-purpose agricultural machinery plant. Although a multi-purpose agricultural machinery plant is usually the only machine building enterprise in the locality, yet it should not be regarded as an " almighty " unit which could be operated in isolation. In fact, it almost cannot carry out any production or repair works without the support of domestic and even foreign machine building industry and basic industries. For example, all the bearings, standardized elements, service parts and belts are provided by specialized plants; some special works such as steel casting, electroplating and even iron casting are done with the cooperation of specialized plants. Specific elements such as blades, shares, chains, etc. which require special manufacturing technology are desirably produced in specialized plants in case they are in great demand. As for the provision of various raw materials, the agricultural machinery plants are still more depedent on other allied sectors. These are the factors worthwile to take into careful consideration at the stage of plant planning.

14. Unremitting renewal of product design and improvement of technical competence

A multi-purpose agricultural machinery plant must uninterruptedly develop new products, and adopt new technologies to improve the quality of their products while reducing the cost in order to achieve good economic results.

China has agricultural machinery research institutes in each and every province, municipality, and county in addition to the national institutions. These institutes develop new products and technologies, in line with local conditions, which are applicable to the multi-purpose agricultural machinery plants. Besides, the plants can also benefit from cooperation with agricultural machinery colleges and professional high schools.

Further, there are research institutes within some of the multi-purpose agricultural machinery plants. The No.3 Agricultural Machinery Plant of Zhongshan County in Guangdong, for instance, has a research institute mainly engaged in the development of tractor-boat and implements. This in-plant institute has made considerable contributions to the technology development and technical force reserve of the plant itself.

15. Standardization is of fundamental importance to technical works. As is known to all, standardization has immediate affects on all aspects of engineering including machine design, manufacturing technology, specifications for equipment and raw materials, spare parts and service, etc.

Standardization ensures desirable quality of products and interchangeability of component parts, so as to make the assembling work easy. Also, standardization is prerequisite for the direct replacement repair technology with which the worn out parts are replaced directly with new ones. To correctly carry out this simple and reliable repair technology is of great importance to both the users and the plants themselves.

Over two hundred items of the National Standard are for agricultural machinery and implements in China. In addition, the plants should have standards of their own. Some plants set their standards somewhat stricter than the National Standard with a view to ensuring the quality of products good enough to meet the requirements of the National Standard. In case there is no ready National Standard for a certain product, the plant should set an appropriate plant standard itself. In order to better develop domestic technology and to enhance cooperations with other countries, it is desirable that the National Standard approaches the International Standard progressively.

16. To apply appropriate technology to ensure best overall economic effect

We have mentioned in section 14 that the plant should make the widest possible use of new designs, and advanced technologies, equipment and materials. However, a plant should never be devorced from its own actual conditions such as scale of production, production facilities, etc. which are even more limited for an agricultural machinery plant. Therefore, to adopt the " appropriate technology " which is technically feasible and economically reasonable to agricultural machine building is considered to be a realistic practice. A few examples of " appropriate technology " are: to make component parts of high strength with nodular cast graphite iron instead of cast steel; to replace special-shaped steel with welding-shaped steel; and to adopt chill cast iron instead of soft-centre steel for plow share and mouldboard, etc.

17. Multi-purpose production needs powerful second line

A multi-purpose agricultural machinery plant must be capable of doing its work, to a certain extent, independently though it is rather dependent on other sectors as mentioned earlier. China's experience suggests that multi-purpose production needs powerful second line, namely, service shop

and tool-making shop fitted with installations making up 20% of the total plant. Workers in the second line should be of higher skill. This second line should be capable of making various technology equipment, simple special machine tools, non-standard equipment, test rigs, and whatever for emergency needs. It also, if necessary, take part in regular production.

18. Quality of product is the lifeblood of multi-purpose plant

The necessity of producing manifold products in small batches makes the price and quality difficult problems of which the quality problem remains first to be solved. Agricultural machines of poor quality will cause waste of labor and fuel, poor field operation, and even heavy losses due to failure of timely farming operation. What is more, the plant will stop production or even close down in case it is incapable of improving the quality of its products without delay. Having drawn the lessons like that, we firmly regard that the quality of agricultural machines, which possess some unique impact on the development of agriculture, is the lifeblood of the plant.

In order to guarantee high quality of products, the plant should seize the key link---quality first. For this reason, the plant ought to set up total quality control system, and equips itself with necessary check personnel and measuring instruments.

The government has stipulated that after the machines are sold out, repair, replacement and even sending back are guaranteed by the plants if the products are not up to the standard. As for price, it is affected by quite a few factors of which the management competence is the key one.

19. Appropriate repairing method and service system

Repair is one of the major jobs for the multi-purpose plant. The repair of agricultural machines should be carried out losing no time, otherwise the peasants will suffer heavy loss.

How to handle the repair jobs for numerous large- and medium-sized tractors and a variety of agricultural machines is a complicate question. We take different measures in different stages. In the past, China built a number of specialized repair plant fitted with manifold special purpose rigs for various repair works. It was fairly useful at that time. However, at present, it is most desirable to adopt direct replacement repair technology because this is a reliable and economical practice. Even then, it is still necessary for the plant to do some special repair works such as mending up the cylinder block, crankshaft grinding, etc. Therefore, the plant should produce sufficient spare parts for its own products, and in the same time have some necessary special repair rigs and measuring devices for special repair jobs.

20. Agricultural machinery plant's location should be convenient for its construction, operation and development. It would be best if a plant is located close by city or town so as to get access to energy and water resources, and better infrastructure. The plant will also benefit from more plentiful labor resource and better daily life facilities for its workers if it is located near city or town. China's agricultural machinery plants are mostly located near the county town. In addition to all the favorable factors mentioned above, a suitable site will also facilitate the cooperation with other factories and sectors.

21. Provide enough room for further development

Numerous agricultural machinery plants in China have developed on the basis of collective workshops or blacksmith's shops. It is apparent and easy to understand that the layouts of quite a few such plants are unreasonable and uneconomical owing to lack of due consideration of development at the stage of drafting. So, when working out the general layout for a multi-purpose agricultural machinery plant it is necessary to plan the buildings, piping and other facilities distinctive for " multi-purpose " and to leave reasonably

plenty room for further development. It is obvious, the multi-purpose agricultural machinery plants in developing countries are both the fundation and starting point of agricultural machinery industry. They will expand along with the development of industry of the country.

22. Give persistent attention to the training of technical personnel

Agricultural machinery plants are, usually, comparatively close to the countryside. Considerable number of workers are coming from countryside and are less skilled. Obviously, the training of workers and making them stable at the work should be taken into serious consideration as a part of the construction planning of the plant. The workers of a multi-purpose plant must have skill no less than that of the ordinary factories and must be expert in one thing and good at many. There should be one or two workers with skill in each and every type of work team as the backbone. Technical personnel had better make up 4-6 % of the total staff of the plant. They are also required to be capable of handling different jobs, to deal with designing of implements, or to deal with manufacturing technologies, as production demand. The authorities concrned have conducted many effective training courses for technical personnel, either in-service or released from work to take part in training.

23. Multi-purpose production needs sound management

As China has experienced, whether or not a multi-purpose plant well keep regular production largely depends on a sound management which is guaranteed by a whole set of effective rules and regulations involing production planning, total quality control, R & D of new product, and technology process control, etc. In fact, the management art of a multi-purpose plant, in comparasion with the specialized plant, is much more complicated due to the variable planning, market and after-sale service.

The management staff must be well trained to be qualified

to run the plant featuring " multi-purpose ". They also need to renew the management with advanced method. In this respect, the No.2 Agricultural Machinery Plant of Foshan applied value engineering principles to thresher production and achieved better economic results.

24. After-sale service---one of the key links for the development of the plant

After-sale service is the last link in the production management, and, in a sense, the starting point for further progress and thrivingness of the plant. It links the end users close to the plant. Does the product quality satisfy the users? How about the applicability of products to agriculture? In one word, all the marketing information and forcast highly depend on this link-up. Such an important matter, the after-sale service, has been often erroneously ignored in the past time in our country. As mentioned in section 9, the production of plant used to be controlled by the government planning departments which are far remote from the county plants. As a result, overstock or out of stock of agricultural machinery products were not uncommon. However, after readjusting the economy system , all plants, no matter they are small or big, start to attach great importance to after-sale service as well as market forcast.

Together with delivery of machines to the countryside, the plants should provide guidance or training for the peasants to operate and repair the machins correctly. It is also an effective measure to avert accidents.

The plants must make every effort to provide sufficient replacement parts. This is the best way for the plants to guarantee their machines working normally and to maintain a good market.

IV. Conclusion

To review the past thirty odd years, we can find that China has achieved good results and also drawn useful lessons from both construction and management of multi-purpose machinery plant. The document briefly summarizes those experiences as well as lessons for your reference. And the summarized sections, or points of importance, will serve as guidlines for elaborating the document " Design and Study of Mulci-purpose Agricultural Machinery Plants ".

It could be well anticipated that the multi-purpose agricultural machinery plant will advance, through unceasing improvement, towards an even brighter future along with the modernization of agriculture and rural industry of the country.

Some agricultural machinery plants in Foshan District of Guangdong Province

Table 1

No.	Manufacturer	Date of founding	Stuff and worker		Area (m^2)		Equipment (unit)		Current product		Total output value (million yuan)	Labor productivity (yuan/person)	Profit (ten thousand yuan)	Fixed assets (million yuan)
			Total	Technical personnel	Total	Floor area of building	Total	Metal-cutting machine tool	Item	Annual production (unit)				
1	No.3 Agricultural Machinery Plant of Zhongshan County	1958	318	4	40329	18023	160	94	tractor-boat thresher winnower bench drill	20 17141 4922 780	3.23	10,098	34.8	1.6
2	No.2 Agricultural Machinery Plant of Shunde County	1972	449	19	14200	14800	136	127	propeller oxegenater spare parts distributer type injuction pump	633 370 16,000 (pieces) 2,208	3.05		5 20 3	
3	No.3 Agricultural Machinery Plant of Sanshui County	1970	229	12	50000	9345	72	45	thresher winnower spare parts rice mill	17,000 600 for 4,000 units 300	2.17	9,300	21	1.6
4	No.2 Agricultural Machinery Plant of Foshan District	1976	398						windrower thresher walking tractor water pump	7,000 36,000	4.57	11,200	11.7	
5	Mouldboard and Share Foundry of Nanhai County	1969	230						mouldboard & share cast pot grinding ball cast railing	200 thousand pieces for each	2.3	10,000	17	
6	Tractor-drawn Implement Plant of Gwangdong	1949	1020	42	70000	37400	428		harvester thresher walking tractor	50 21,000	5.16		7.27	4.6

Products of some agricultural machinery plants
in Foshan District of Guangdong Province Table 2

No.	Manufacturer	Traditional product
1	No.3 Agricultural Machinery Plant of Zhongshan County	tractor- boat, manual thresher, silage mixer, animal-drawn plow bottom, sheet metal shear, puncher, bench drill, sickle
2	No.2 Agricultural Machinery Plant of Shunde County	river boat propeller, oxygenater, distributer type injection pump assembly, 190 cylinder block, 190 cylinder head, plastic squeezer, fan shaft, fuel injector
3	No.3 Agricultural Machinery Plant of Sanshui	manual thresher, electric-powered rice thresher, winnower, rice mill, walking tractor(4hp), dryer, spare parts, brickmaking machine
4	No.2 Agricultural Machinery Plant of Foshan District	winnower, thresher, walking tractor(4hp), mini-pump
5	Mouldboard & Share Foundry of Hainan County	Share & mouldboard, cast pot, grinding ball, cast railing
6	Tractor-drawn Implement Plant of Guangdong	harvester, disk mower, single-bottom bush plow, plow series(1 to 6 bottom), paddy field harrow, thresher, walking tractor and accessories (single bottom ploe, spike harrow, pulverizer, rotary tiller, mower, windrower, trailer, thresher, pump, sprayer, etc.), single cylinder washer(household), washer (50kg, industrial), water purifying equipment